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Conservation of natural heritage in the Bursa Hanlar District: An investigation into monumental plane trees*

Bursa Hanlar Bölgesi'nde doğal mirasın korunması: Anıt çınar ağaçları üzerine bir inceleme

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ABSTRACT

Objective: This study aims to identify the difficulties and challenges faced by monumental trees in a historically protected area, compare their current and desired living conditions and develop solutions to the issues they experience.

Material and Methods: The study assessed the current living conditions and physical state of the monumental plane trees. The differences were identified by comparing their current condition with their expected size and habitat to be protected. Monumental trees were examined in terms of trunk and crown health status, and solution proposals were developed for the identified problems.

Results: The data revealed that 85% of the monumental trees were below the required height and diameter. None of the monumental trees in the study area had sufficient living space. Furthermore, 95% of the trees exhibited inadequate root areas, and their forms had deteriorated due to deep pruning; 90% showed signs of branch dieback, 70% had galls and swellings, 55% insufficient crown area, and 50% had cavities and rot in their trunks.

Conclusion: To ensure the sustainability of the monumental trees in the study area, they must be protected according to the TS 13190 standard, with special care and rehabilitation measures implemented. Without these interventions, many of these monumental trees, which have already lost many characteristics, may disappear within a few decades.

Keywords: Maintenance, monumental trees, plant health, sustainability

ÖZ

Amaç: Bu çalışmada, UNESCO Dünya Miras Listesi'nde yer alan Bursa Hanlar Bölgesindeki anıt çınar ağaçlarının mevcut yaşam koşulları ile olması gereken yaşam koşullarının karşılaştırılması, bulundukları koşullarda maruz kaldıkları olumsuzlukların belirlenmesi ve çözüm önerilerinin geliştirilmesi amaçlanmıştır.

Materyal ve Yöntem: Çalışmada, anıt çınar ağaçlarının mevcut yaşam koşulları ve fiziki durumlarının tespiti yapılmıştır. Olması gereken boyutları ve korunması gereken yaşam alanı ile mevcuttaki durumları karşılaştırılarak farklar ortaya konulmuştur. Ağaçlar, gövde ve taç sağlık durumları açısından incelenmiş, tespit edilen problemler için çözüm önerileri geliştirilmiştir.

Araştırma Bulguları: Elde dilen verilere göre anıt ağaçların %85'nin olması gereken boy ve taç çapının altında kaldığı tespit edilmiştir. Çalışma alanındaki hiçbir anıt çınar ağacı için yeterli yaşam alanı bırakılmamıştır. Anıt ağaçların; yüzde 95'inin yetersiz kök alanına sahip olduğu ve derin budamalardan kaynaklı taç formunun bozulduğu, %90'ının dal kurumalarına, %70'inin ur ve şişkinliklere, %55'inin yetersiz taç alanına sahip olduğu, %50'sinin gövdesinde kovukların ve çürüklerin oluştuğu saptanmıştır.

Sonuç: Çalışma alanındaki anıt çınar ağaçlarının sürdürülebilirliği için TS 13190 Nolu standarda uygun olarak korunması, özel bakım ve rehabilitasyon uygulanması gerekmektedir. Kanunlarla belirlenen koruma alanı sınırlarına titizlikle uyulmalıdır. Aksi takdirde hâlihazırda birçok özelliğini kaybetmiş olan bu anıt çınar ağaçlarının birçoğu birkaç onyılda yok olup gidecektir.

Anahtar sözcükler: Bakım, anıt ağaçlar, bitki sağlığı, sürdürülebilirlik

INTRODUCTION

Monumental trees are the longest-living natural monuments and hold cultural and historical value. They symbolize immortality, power and peace. They are also the most important heritage of nature (Demir, 2019; Yener, 2022; Budău et al., 2025). Examples of these trees, which are tied to both sad and happy stories, can be found throughout our country (Asan, 2010). They also play a crucial role in sustaining traditions and maintaining ecological balance due to their historical significance (Cannizzaro & Corinto, 2014; Grigoriadis, 2021; Bulut, 2024).

Monumental trees are defined in the Regulation on the Procedures and Principles Regarding the Determination, Registration, and Approval of Protected Areas (RG, 28358) and Principle Decision No. 110 (2020) of the Ministry of Environment, Urbanization, and Climate Change (MEUCC). They are defined as “trees that exceed the typical dimensions of their species in age, diameter, and height, and/or hold a special place in local folklore, culture, and history, and/or possess a natural longevity that connects the past with the present and the future” (Şişman, 2014; Yener, 2022; Bulut, 2024). In our country, a cradle of many cultures and civilizations, numerous trees have survived the past that can be classified as monumental (Anonymous, 2016; Aslan, 2016; Bulut, 2024). In Evliya Çelebi's travel books, ten monumental trees in the region between Tavas and Muğla were described as "trees to be taken as an example" (Baytop, 2004).

Monumental trees are characterized by physical features that captivate the eye, including height, diameter, and crown shape. Their impressive structures and heights (Şişman, 2014; Budău et al., 2025), along with lifespans that can reach 15 to 20 times that of humans (Asan, 2010), draw significant attention. These trees symbolize cultural commitment, love of nature, and environmental awareness, making them important elements of both rural and urban landscapes (Atik et al., 2017; Polat, 2017; Demir, 2019; Genç & Güner, 2003; Grigoriadis, 2021). In Turkish societies, certain species of trees are regarded as sacred, linking them to holy sites. This belief has historically led to the planting of trees around places of worship and cemeteries (Arslan, 2014). Occasionally, these trees have also served as symbols of emotions and sources of inspiration for poems and songs (Şişman, 2014; Bulut, 2024). As a result, the relationship between Turks and trees is notably stronger than in many other cultures (Kuru, 2022). Additionally, some trees are valued for their unique trunk shapes and longevity, earning the designation of "monumental trees" (Uysal, 2014). Due to their symbolic significance and positive psychological effects, monumental trees are carefully protected worldwide (Efe et al., 2010; Bulut, 2024). They are respected for their associations with power, wealth and greatness. Also, they are respected for their roles in mythology and epics, their use as symbols in national flags and treaties, and their contributions to tourism and trade in their regions (Asan, 1987). Furthermore, they assist in estimating past climate events in dendroclimatological studies (Asan, 2010; Zencirkıran et al., 2016). This ecological heritage serves as a focal point and is a valuable resource for ecotourism. For instance, the İnkaya Plane Tree at the foothills of Uludağ in Bursa stands out as a significant monumental tree (Zencirkıran et al., 2016; Erken et al., 2019; Sen & Bahadir, 2022). Monumental trees are a part of natural or cultural landscapes and provide natural heritage features to the landscape in cities where natural elements are rapidly disappearing (Atik et al. 2017; Sen & Bahadir, 2022). Each monumental tree has a mystical or folkloric story in the local culture and witnesses national and historical events (Polat, 2017; Güneş & Önder, 2022; Petino et al., 2024). In historical and cultural heritage, monumental trees are the entities that leave the most traces in people's psychology and memory, whose appearance and size change according to years and seasons (Sarıbaş, 2015; Mejorado Velazco et al. 2020; Camarero et al., 2024). Therefore, the sustainability of monumental trees and their transfer to future generations are very important (Chen, 2015; Demirtaş & Özden, 2015; Grigoriadis, 2021).

The plane tree, a monumental species prevalent in Anatolia, particularly in Bursa, symbolizes majesty and permanence in Turkish culture (Özkaplan Yörüklü, 1997). For thousands of years, it has

represented power and authority in the region (Efe et al., 2010; Aslan et al., 2016). However, the monumental trees—historical elements of the Hanlar Region, one of Bursa's most significant historical sites—are diminishing in size, losing vitality, drying out, and collapsing due to wind. While the criteria for classifying a tree as monumental include dimensional, cultural, and visual features as outlined in Principle Decision No. 110 on the Determination of Monumental Trees, few monumental trees in Bursa have maintained their size characteristics. It is crucial to ensure the healthy transfer of these trees to future generations. Therefore, protecting their health, diagnosing issues, finding solutions, and taking necessary actions are priority concerns (Chen, 2015; Demirtaş & Özden, 2015; Grigoriadis, 2021).

According to Article 63 of the Constitution, the state is responsible for protecting natural assets. Provision 3/a-2 of KTVKK No. 2863 (1983) classifies monumental trees as immovable natural assets. Consequently, the state is obligated to take all necessary measures to safeguard these trees (Çevikçelik, 2021; Bulut, 2024). This responsibility is carried out by the Ministry of Environment, Urbanization, and Climate Change, specifically through the General Directorate of Protection of Natural Assets, a unit of ÇŞİDB (Güneş & Önder, 2022; Bulut, 2024).

Key regulations on monumental trees include several official documents. One is the Regulation on the Procedures and Principles for the Determination, Registration, and Approval of Protected Areas (2012). It was published in the Official Gazette on July 9, 2012 (No. 28358) and amended in 2013, 2017, 2020, and 2022. Another important document is Principle Decision No. 110, issued by the Ministry of Environment and Urbanization. It was approved during the 37th meeting on September 10, 2020. Clause (d) of this decision states that the crown diameter projection should define the protection area of monumental trees. The second paragraph of clause d prohibits ground covering, excavation, and construction activities that could harm the tree's root structure, nutrition or prevent water from reaching the roots within the protection area. It also prohibits any activities that may damage the crown, trunk, and roots or affect other plants in the vicinity. Furthermore, any activities within the protection area require permission from the Regional Commissions.

Despite this principle decision, there is lack of compliance in Bursa, many other areas in Türkiye and the world, where the habitats of monumental trees are frequently violated, threatening their survival (Gül, 2019; Çevikçelik, 2021; Yener, 2022; Jacobsen et al., 2023; Bulut, 2024).

This study aims to evaluate the current status and issues of the monumental plane trees in Bursa Hanlar Region Core Area, a UNESCO World Heritage Site. It will compare their existing condition to the desired status, identify the discrepancies, and propose solutions for sustainability.

The study fills a significant gap in the care and conservation of monumental plane trees in the Bursa Hanlar District. It emphasizes the need to evaluate the structural and vegetal heritage of our historical sites together. It highlights the fact that our living historical monuments, unlike structural monuments, require maintenance for their sustainability and the consequences of failure to do so. The detailed data obtained in the study and the proposed solutions developed in accordance with TSE 13137 (2005) and TSE 13190 (2006) standards make the study original and valuable for both scientific and practical purposes.

MATERIALS and METHODS

Materials

The study was conducted in Hanlar Region located in Bursa Province (40° 11′ 30″ N, 29° 3′ 40″ E), which has the highest concentration of historical artifacts and monuments in the city (URL-1, 2023). The historical region of Bursa was added to the UNESCO World Heritage temporary list in 2000. Figure 1 illustrates the core area and buffer zone of Hanlar Region.

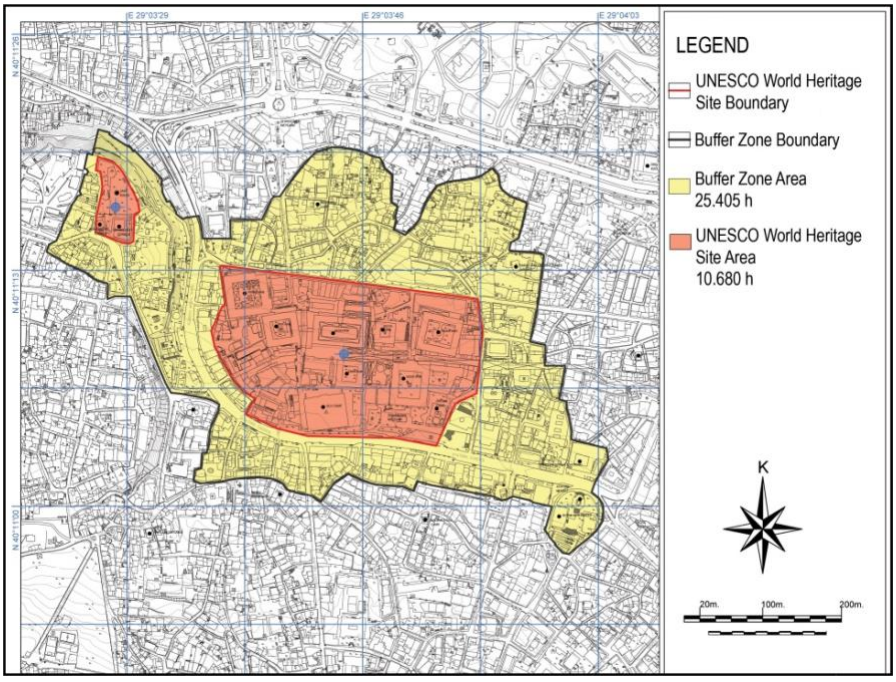

Figure 1. Hanlar Region core area and buffer zone (Bursa Site Management Unit, 2025).

Şekil 1. *Hanlar Bölgesi çekirdek alan ve tampon bölge (Bursa Alan Başkanlığı, 2025).*

This study examines 20 monumental plane trees located in the core area of Bursa Hanlar Region, and these trees are protected under Law No. 2863 on the Protection of Cultural and Natural Assets (1983) (Figure 2).

Figure 2. The monumental trees that are the material of the study and their locations in the Hanlar Region Core Area (Bursa Site Management Unit, 2025).

Şekil 2. *Çalışmanın materyali olan anıt ağaçlar ve Hanlar Bölgesi Çekirdek Alan'daki konumları (Bursa Alan Başkanlığı, 2025).*

Table 1 lists the locations of the monumental trees in the study, along with their inventory number codes and the qualities they currently protect.

Table 1. List of monumental plane trees examined in the study, their locations and characteristics

Çizelge 1. *Çalışmada incelenen anıt çınar ağaçlarının listesi, konumları ve özellikleri*

No	Trees	Inventory number	Tree code	Currently Protected Monument Tree Characteristic	Location	Coordinate
1	*Platanus orientalis*	16-2	OSM-525	Age-History	Pirinçhan Courtyard	X:419967.7103 Y:4450546.44619
2	*Platanus orientalis*	16-1	OSM-524	Age-History	Pirinçhan Courtyard	X:419964.63286 Y:4450564.73414
3	*Platanus occidentalis*	18-1	OSM-527	Age-History	in front of Hünkâr Turkish delight	X:420036.49948 Y:4450567.19733
4	*Platanus occidentalis*	70	OSM-528	Age-History	İvazpaşa Mosque Garden	X:420069.32413 Y:4450557.80916
5	*Platanus orientalis*	49	OSM-533	Age-History	in front of Çınar kebab	X:420062.52143 Y:4450326.41043
6	*Platanus occidentalis*	56	OSM-532	Age-History	in front of Yesevi Kebap	X:420043.63154 Y:4450328.84947
7	*Platanus orientalis*	51-6	OSM-534	Age-History	in front of Çınar Cafe	X:420180.64581 Y:4450333.07124
8	*Platanus orientalis*	37-1	OSM-535	Age-History	Behind Ulu Mosque Fountations	X:420155,33205 Y:4450352.36817
9	*Platanus orientalis*	38-1	OSM-536	Age-History	Behind Ulu Mosque Fountations	X:420155.56627 Y:4450355.7036
10	*Platanus orientalis*	39-1	OSM-537	Age-History	Behind Ulu Mosque Fountations	X:420155.85869 Y:4450358.15214
11	*Platanus orientalis*	51-5	OSM-539	Age-History	Across from Bursa Silk Shop	X:420193.22221 Y:4450358.01652
12	*Platanus orientalis*	51-4	OSM-540	Age-History	Kozahan Entrance right side	X:420258.86971 Y:4450354.66941
13	*Platanus occidentalis*	30-1	OSM-549	Age- crown diameter	Kozahan Courtyard	X:420254.39307 Y:4450411.35407
14	*Platanus occidentalis*	30-4	OSM-551	Age- crown diameter - History	Kozahan Courtyard	X:420232.86757 Y:4450386.90317
15	*Platanus occidentalis*	30-3	OSM-552	Age-History	Kozahan Courtyard	X:420232.97066 Y:4450395.84824
16	*Platanus orientalis*	30-2	OSM-553	Age-History	Kozahan Courtyard	X:420234.92759 Y:4450409.03989
17	*Platanus occidentalis*	30-6	OSM-548	Age-History	Kozahan Inner Courtyard	X:420285.79416 Y:4450408.74133
18	*Platanus orientalis*	31-3	OSM-546	Age-History	Orhan Mosque Garden	X:420308.64885 Y:4450373.37046
19	*Platanus orientalis*	31-2	OSM-547	Age-History - Folkloric	Orhan Mosque Garden	X:420285.93762 Y:4450379.33498
20	*Platanus orientalis*	51-1	OSM-543	Age-History	Behind Orhan Mosque	X:420300.7953 Y:4450335.58255

Methods

The method of this study consists of three stages.

First stage

The study commenced with a literature review that involved researching information about monumental trees, correlating relevant laws and regulations regarding their protection and examining previous studies on the subject.

Second stage

This stage involved fieldwork, in which measurements of the height, trunk diameter, trunk circumference, and crown diameter of the monumental trees in Bursa Hanlar Region—designated as the study area—were taken. The ages of the trees were determined using the monumental tree plates affixed to their trunks. Concurrently, measurements were made of the soft ground living area available for the roots. The presence of structures within the designated living space for the trees and the paving status in this area were assessed, and distance measurements were recorded. Observations were conducted regarding tip drying (top collapse), side branch drying, disease factors, trunk decay, and improper pruning practices, with observation reports prepared for each tree (Pan et al., 2025).

Height measurement: The distance from the soil level to the highest point of the branches of the tree was measured in meters using a laser meter (Pietraszko et al., 2022).

Trunk circumference and diameter measurement: The trunk circumference was measured in meters at a height of 130 cm from the soil surface using a tape measure. The trunk diameter was measured from the same height (Pietraszko et al., 2022) (Figure 3).

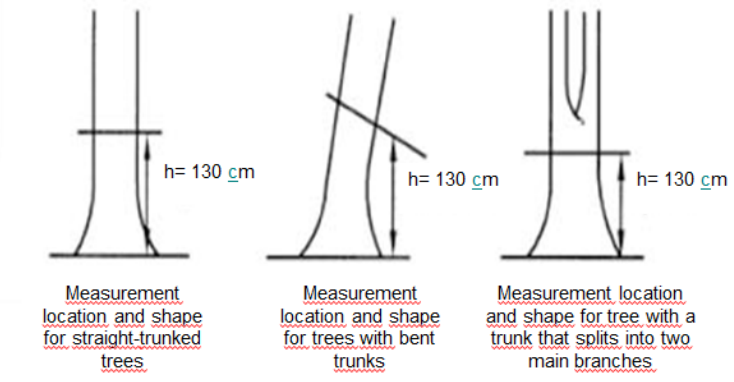

Figure 3. Measurement location of trunk diameter and trunk circumference (Uzun, 1997; Pietraszko et al., 2022).

Şekil 3. *Gövde çapı ve gövde çevresi ölçüm yeri (Uzun, 1997*; *Pietraszko et al., 2022).*

Crown diameter measurement: To measure the crown diameter, the crown projections of the tree were taken in the main directions (North-South and East-West), and the diameters were measured using a tape measure. The average of these two values was recorded as the crown diameter (Pietraszko et al., 2022; Yang et al., 2024) (Figure 4).

Monumental tree height, crown, and living space status ınformation: Situation charts were created for monumental trees, along with plan and section view drawings made using AutoCAD and Photoshop, to compare the current and required measurements of monumental trees in terms of height, crown diameter, and living space areas. Studies by Genç & Güner (2001), Gül (2019), Kuru (2022), and Camarero et al. (2024) informed the development of this status information. The measurement data collected from our field study were processed into status charts. In addition to current measurements,

information on age, height, crown diameter, trunk diameter, circumference, and both current and ideal living space were compiled into status lists. The monumental features section details which characteristics (age, height, diameter) qualify a tree as monumental (Polat, 2017; Çevikçelik, 2021; Yener, 2022; Yang et al., 2024) (Figure 4).

In the section on health information and problem identification, the conditions affecting the health and integrity of the tree are outlined. This includes the presence of fungal infection, Sap exudation from the trunk, crown top collapse, deep pruning damage, branch dieback, galls and swellings on the trunk, and cavities and rot. Regarding the living space of the tree (protection area), the available soft soil for roots and growth and the ground covering material were assessed (Wilkaniec et al., 2021; Pietraszko et al., 2022; Jacobsen et al., 2023).

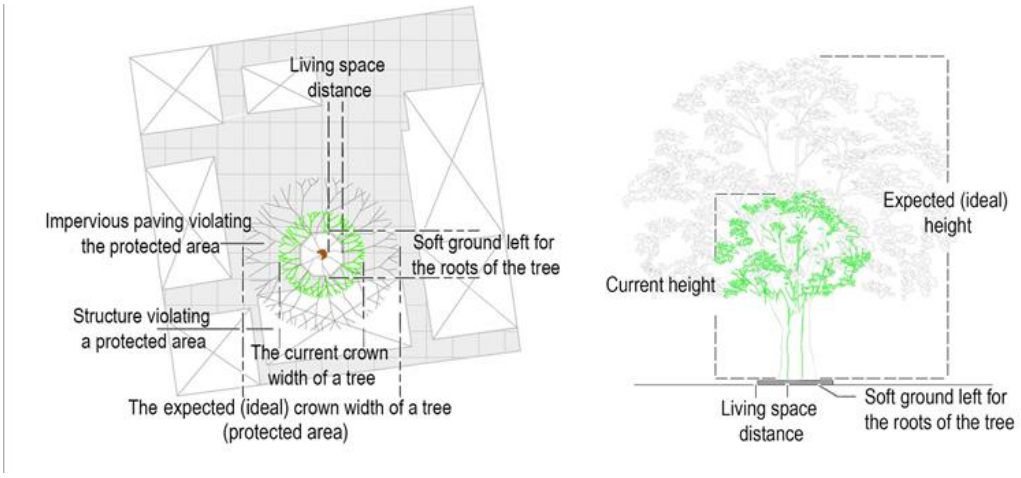

Figure 4. Measured dimensions of monumental trees, and comparison of current and ideal dimensions.

Şekil 4. *Anıt ağaçlarda ölçülen boyutlar ve mevcut ile olması gereken boyutların karşılaştırılması.*

Later, a table was created for the studied monumental trees, calculating their required height, crown diameter dimensions according to age, and necessary protection area. This table was developed based on Principle Decision No. 110 regarding the designation of monumental trees as natural entities, along with studies by Genç & Güner (2003), Gül (2019), and Kuru (2022). According to Principle Decision No. 110 and Standard No. TS 13137, the average height of first-class plane trees (*Platanus* spp.) should exceed 25 m. To qualify as a monumental tree, the Eastern Plane Tree must have a minimum height of 25 m and a minimum crown diameter of 20 m, as per Standard No. TS 13137, Genç & Güner (2003), and Yang et al. (2024).

To determine the required crown diameters of monumental plane trees, the trees in the study area were divided into age groups with 20- year intervals, resulting in nine groups: 120-140, 141-160, 161-180, 181-200, 201-220, 221-240, 241-260, 261-280, and 281- 460. Average crown diameter and height data for each age group were provided by Tatlı et al. (2000), Genç et al. (2002), Genç & Güner (2003), Şişman (2014), Aslan (2016), and Gül (2019). The data based on measurements taken from healthy monumental *Platanus orientalis* trees listed in Mejorado Velazco et al. (2020), Güneş & Önder (2022), Kuru (2022), and MEUCC (2025) as they were measured in the field. Subsequently, the height and crown diameter each monumental tree should have according to its age group were calculated based on the collected data.

The narrowest area between the trunk of the monumental tree and the hard ground was measured in centimeters to assess the available living space for the tree. In calculating the differences between the required (expected) and existing living space, the tree crown projection limit was considered the outer boundary of the living space (protected area) (Principle Decision No. 110, 2020; Yener, 2022; Pan et al., 2025).

Third stage

At this stage, deficiencies and solutions were proposed for the problems identified during the field studies.

RESULTS and DISCUSSION

The data obtained at the end of the study regarding the dimensions and living space of 20 monumental plane trees in Hanlar Region Core Area are presented in Table 2. The findings indicate that the tree height is significantly below the required 39 m specified for Eastern and Western plane trees in Annex 1 of Principle Decision No. 110. Only three monumental trees meet the minimum height standard of 25 m for first-class forest tree species, as specified by Genç & Güner (2003) and Aslan (2016) in Principle Decision No. 110. Seventeen trees fall below the minimum standards for monumental plane trees. Based on the average dimensions of monumental plane trees in Türkiye, only two trees meet the required height for their age group. These trees are located behind the fountains in the Ulucami Garden. They are notably distanced from surrounding structures, are close to a water source, and have larger living spaces than other species. Monumental plane tree number 4, which exceeds the expected height, is situated in the garden of İvaz Paşa Mosque. The growth of the tree is likely due to side branch pruning because of its proximity to the mosque wall. It should have averaged 25.85 m, but its actual average height is 19.00 m. In the study by Akgün et al. (2018), 4 out of 5 monumental plane trees surpassed the 25 m standard, while this rate was much lower in our study. The reduced height in these trees is attributed to the collapse of their tops due to a lack of maintenance.

When examining the crown diameter as one of the dimensional characteristics of monumental trees, it is important to note that the minimum crown diameter standard for such trees, as stipulated by Genç et al. (2002), Aslan (2016) and as outlined in Annex-4 of Principle Decision No 110 is 20 m. In the study area, three monumental trees meet this criterion. Specifically, trees numbered 7 (located in front of Çınar Cafe), 9 (behind Ulu Mosque Shelters), and 12 (at the entrance of Koza Han) qualify. Notably, trees numbered 7 and 12 are situated in Gazi Orhan Park, where they enjoy a more expansive living space and are distanced from surrounding structures. Conversely, tree number 9 is positioned on the boundary of Ulucami Garden and Gazi Orhan Park, also benefiting from a relatively spacious living area and protective zone. It is observed that 50% of the protection area for monumental tree number 7, 75% of the protection area for monumental tree number 9, and 40% of the protection area for monumental tree number 12 is designated as soft permeable ground (grass area). Among the monumental plane trees, only tree number 12, located in the square of Gazi Orhan Park across from the entrance of Koza Han, meets the expected crown width averages established for healthy monumental plane trees. With a crown diameter of 29.64 m, it singularly embodies the characteristics of a monumental tree within the study area. In terms of crown diameter, a significant majority of the trees (85%) fall short of the expected average dimensions of 25.65 m, with actual measurements averaging only 14.89 m (Table 2).

Asan (2010) posited that the most salient characteristic of monumental plane trees is their size, which significantly enhances their impact on human and social psychology. However, in the context of the present study, it was determined that there are only three monumental plane trees in the study area, representing a mere 15% of the total. In contrast, Akgün et al. (2018) reported more favorable findings in their research; specifically, two out of five measured plane trees fell below the 20 m diameter standard, while three were measured above this threshold.

Table 2. Differences between the dimention required to be of the studied monumental plane trees according to their ages and their current dimensions

Çizelge 2. *Çalışılan anıt çınar ağaçlarının yaşlarına göre olması gereken ortalama ideal boyutları ile mevcuttaki boyutları arasındaki farklılıklar*

Monumental tree species	Age (2025)	Height of the monumental tree (m)		crown diameter (m)		Trunk diameter (cm)	Trunk circumference (m)	Living space distance (m) (From trunk to crown edge border)		Floor covering material in the monumental tree canopy cover
		Current dimension	ideal dimension*	Current dimension	ideal dimension**			Current (m)	ideal distance according to the existing crowns (m)***	
1. *Platanus orientalis*	206	10	26	10.80	26	113	3.13	2.20	5.40	Concrete coating
2. *Platanus orientalis*	186	17	25	19.07	25	119	3.70	2.20	9.53	Concrete coating
3. *Platanus occidentalis*	131	18	25	13.41	25	72	2.25	0.20	6.70	Granite cube stone flooring + Concrete
4. *Platanus occidentalis*	156	28	25	18.43	25	88	1.71	0.60	9.22	Andesite slab stone flooring
5. *Platanus orientalis*	226	19	26	9.60	26	156	4.44	1.10	4.80	Granite cube stone flooring + Concrete
6. *Platanus occidentalis*	131	8	25	5.74	25	80	2.98	0.50	2.87	Andesite slab stone flooring
7. *Platanus orientalis*	208	24	26	23.21	26	170	5.10	0.50	11.61	Green area+Basalt slab stone flooring
8. *Platanus orientalis*	271	27	27	14.02	27	125	3.50	0.35	7.01	Cube stone flooring
9. *Platanus orientalis*	141	23	25	23.00	25	112	3.70	0.60	11.50	Green area + Natural stone flooring
10. *Platanus orientalis*	160	25	25	19.54	25	130	4.03	1.35	9.77	Green area + Paving stone flooring
11. *Platanus orientalis*	236	16	27	14.06	26	170	5.10	1.30	7.03	Green area + Paving stone flooring
12. *Platanus orientalis*	136	22	25	29.64	25	200	5.35	2.60	14.82	Green area + Paving stone flooring
13. *Platanus occidentalis*	247	15	27	8.88	26	146	4.88	1.00	4.44	Cube stone flooring
14. *Platanus occidentalis*	126	19	25	10.07	25	47	1.56	1.00	5.03	Cube stone flooring
15. *Platanus occidentalis*	146	15	25	14.34	25	77	2.55	1.00	7.17	Cube stone flooring
16. *Platanus orientalis*	187	21	25	14.50	25	117	2.64	1.20	7.25	Cube stone flooring
17. *Platanus occidentalis*	252	19	27	15.15	27	172	5.21	0.20	7.58	Cube stone flooring
18. *Platanus orientalis*	446	16	30	7.41	28	284	8.95	0.00	3.72	Slate stone flooring
19. *Platanus orientalis*	181	19	25	10.07	25	114	3.28	0.30	5.03	Slate stone flooring
20. *Platanus orientalis*	206	19	26	16.85	26	115	3.25	1.50	8.43	Green area + Paving stone flooring
Mean	198.95	19.00	25.85	14.89	25.65	130.3	3.87	0.99	7.45	

* According to the Annex-1 of the Principle Decision No. 110 and Genç & Güner (2003), the minimum tree height determined for the Eastern Plane Tree to be selected as a monumental tree is 25 meters.

** The minimum crown diameter standard required for a monumental tree to receive full points in the determination of the monumental tree given in the Annex-4 table of the Principle Decision No. 110 is 20 m.

*** According to the principle decision No. 110 taken at the meeting No. 37 of the Ministry of Environment and Urbanization dated 10.09.2020, the conservation area (Living space) that have to be between the trunk and the crown adge border has calculated by taking into account the current crown diameter of the tree.

An analysis of the living space data reveals significant deficiencies in spatial dimensions and associated health issues that fall below established standards. Notably, no monumental plane tree within the study area has been afforded the requisite living space as delineated in the principle decision numbered 110, which designates specific protection areas. The current average living space distance measured at 0.99 m is substantially less than the recommended distance of 7.45 m, derived from average crown widths calculated based on the identified age groups. Although some trees exhibit the use of soil-jointed flooring materials in their living spaces, these joints result in surfaces that exhibit inadequate permeability due to intensive use and compaction (Güneş & Önder, 2022). Non-permeable floor covering materials and soil compaction emerge as primary challenges for plant health in urban environments (Genç & Güner, 2003). According to TSE 13190, practices that would lead to soil compaction within living space should be strictly prohibited. The monumental tree in optimal condition, identified as plane tree number 12, located in Orhan Gazi Park across from the entrance of Koza Han, maintains a living space distance of 2.6 m, making it the only monumental tree that complies with the minimum standard regarding crown diameter. This observation underscores the critical importance of designated living space (protection areas) for the healthy development and sustainability of monumental trees. It is essential to recognize that the living space currently allocated are based on the problematic crown widths of the trees. When calculating according to the appropriate crown widths corresponding to the age of the monumental trees, it becomes evident that a protection area of 12.83 m should be maintained considering the trunks of these trees, in accordance with the standards outlined in Principle Decision Number 110 and the calculated average crown diameters of the twenty trees assessed.

According to Principle Decision No. 110, Genç & Güner (2003), and Yener (2022) in designated protection areas, ground coverings that may adversely affect the root structure and nutritional supply of trees and also inhibit groundwater access to the root system, are prohibited. The protection area for monumental trees is documented alongside the trees themselves, and violations of this regulation necessitate penal action in accordance with pertinent laws and regulations (Çevikçelik, 2021; Sapan, 2024). Alp & Baylan (2017) assert that the protection area for monumental trees should be a minimum of 5 m to the crown projection. Considering the constraints posed by existing historical structures, which cannot be demolished, and the location of the historical trade center characterized by high human movement, the most rational, straightforward, and feasible solution is to employ highly permeable materials for ground coverings around the monumental trees.

The investigation revealed ten distinct problems affecting the monumental plane trees studied, as summarized in Table 3. These issues were found to negatively impact the overall size and health of the monumental trees (Table 3).

As illustrated in Table 3, one of the most significant challenges faced by the monumental plane trees in the study area is the insufficient space allocated for their roots, with 95% of the trees experiencing this issue. According to Principle Decision No. 110 and TSE 13190, the area corresponding to the crown projections of the trees is designated as a protection area, which should ideally remain as soft ground. Martinez & Coelho-Duarte (2023) reported a 50% incidence of root-related problems in their study of 16 *Platanus hispanica* plane trees in Mendoza, Argentina; this rate was observed to be higher in the present study.

A significant issue observed among the monumental plane trees in the study area is the prevalence of deep pruning, which affects 95% of the specimens. Two contributing factors that cause deep pruning of these monumental plane trees are branch dieback and crown top collapse. Branch dieback was observed in 90%, crown top collapse was 35% of the trees included in the scope of the study. Additionally, the proximity of surrounding structures and other trees within the designated protection area further exacerbates the situation. The close proximity of these elements has impeded the natural branching and crown formation of the monumental trees, necessitating pruning interventions. This problem, defined as insufficient crown area, was identified in 55% of the of the assessed trees. This practice has resulted in an imbalance in certain trees and has led to a complete alteration of the natural form in others.

Table 3. Problems detected in monumental plane trees in the Bursa Hanlar Region

Çizelge 3. *Çalışma alanındaki anıt çınar ağaçları ve tespit edilen problemleri*

Monumental Trees	Problems									
	Fungal infections	Sap exudation	Crown top collapse	Deep pruning	Branch dieback	Galls and swellings	Cavities and rots	Insufficient space for roots	Insufficient crown area	Soil compaction and hardening
1. *Platanus orientalis*	✓		✓	✓	✓	✓	✓	✓	✓	
2. *Platanus orientalis*		✓	✓	✓	✓	✓		✓	✓	
3. *Platanus occidentalis*	✓			✓	✓	✓	✓	✓	✓	✓
4. *Platanus occidentalis*	✓			✓	✓			✓	✓	✓
5. *Platanus orientalis*				✓	✓	✓	✓	✓		
6. *Platanus occidentalis*	✓		✓	✓	✓	✓	✓	✓	✓	✓
7. *Platanus orientalis*			✓	✓	✓	✓	✓	✓		
8. *Platanus orientalis*				✓	✓			✓		
9. *Platanus orientalis*				✓	✓			✓		
10. *Platanus orientalis*				✓	✓			✓		
11. *Platanus orientalis*	✓	✓	✓	✓	✓	✓	✓	✓	✓	
12. *Platanus orientalis*						✓				
13. *Platanus occidentalis*	✓			✓	✓	✓	✓	✓		✓
14. *Platanus occidentalis*				✓	✓	✓		✓	✓	✓
15. *Platanus occidentalis*	✓			✓	✓	✓		✓	✓	✓
16. *Platanus orientalis*				✓	✓			✓	✓	✓
17. *Platanus occidentalis*	✓			✓	✓		✓	✓	✓	✓
18. *Platanus orientalis*	✓		✓	✓	✓	✓	✓	✓		✓
19. *Platanus orientalis*			✓	✓	✓	✓	✓	✓		
20. *Platanus orientalis*				✓		✓		✓	✓	
TOTAL (number)	9	2	7	19	18	14	10	19	11	9

Deep pruning significantly compromises the aesthetic integrity of monumental trees, and also poses substantial risks to their health by inducing wound formation. As per TSE 13190 standard, monumental trees should only be subjected to intentional pruning when their physiological needs and location necessitate such interventions. Furthermore, our study revealed that two-thirds of the examined trees exhibited branch desiccation. In contrast, Martinez and Coelho-Duarte (2023) identified a 44% incidence of crown top collapse and branch dieback in a study involving a different species of plane tree in Argentina, a rate that was surpassed in our findings. Contributing factors to this phenomenon include insufficient root space, soil compaction, and hardening (45%). It is posited that these deficiencies are primary contributors to the myriad of issues observed in monumental trees. The sealing of the soft ground within the tree's crown projection—through concrete, asphalt, or impermeable soil compaction—disrupts the essential water and air circulation, leading to developmental disorders due to deficiencies in water and oxygen (Genç & Güner, 2003). The TSE 13190 standard explicitly prohibits activities that would result in soil compaction within the living area of monumental trees. When a tree is unable to obtain sufficient water, nutrients, and oxygen from its root zone, it experiences top collapse and branch desiccation. Attempts to rectify these issues through pruning only exacerbate the problem, resulting in a

gradual loss of the original dimensions of the tree, which constitutes its primary function. Although many monumental trees may not exhibit obvious signs of distress, it is believed that the most significant issues arise from these underlying deficiencies.

One of the identified issues is the prevalence of galls and swellings formed on the trunks, accounting for 70% of cases. This phenomenon primarily results from physical interventions related to human activities, improper pruning, and exposure to diseases and pests affecting the tree trunk. The allowance of harmful activities within the conservation space established under principle decision number 110, coupled with inadequate control measures for diseases and pests, facilitates the occurrence of such damage. It is imperative to safeguard the monumental trees within the Bursa Hanlar District from these interventions and to mitigate the formation of galls and swellings by adhering to maintenance protocols in accordance with TS 13190 standards, as stipulated by principle decisions number 110 and 666. However, it appears that insufficient care is being administered. The occurrence of galls and swellings observed in our study was similarly noted at a rate of 75% in research conducted by Martinez & Coelho-Duarte (2023) on a different plane tree species in Argentina. Furthermore, the cavities and rots observed in our study, at a rate of 50%, aligns closely with findings from Martinez & Coelho-Duarte (2023), which reported a rate of 63% in Mendoza, Argentina.

In our study, fungal infections were identified in 45% of the trees, while sap exudation was observed in 10%. Both conditions were determined to be associated with mechanical injuries sustained by the trees.

Our results indicate significant differences in tree height and trunk diameter between the current and expected dimensions of the monumental plane trees within the study area. It has been noted that monumental trees meeting or closely approaching the expected dimensions are subjected to only 2-3 of the identified issues. In contrast, those trees that fall significantly short of the expected dimensions experience the majority of the identified problems. This observation underscores the extent to which the challenges faced by monumental trees impact their growth dimensions.

As a consequence of the various issues identified in the monumental plane trees within the study area, it has become evident that their current status diverges from the anticipated condition. However, as articulated by Çevikçelik (2021), Bulut, (2024) and Sapan (2024), adherence to the preventive measures outlined in Principle Decision No. 666 of the Supreme Council for the Protection of Cultural and Natural Assets, which addresses the “Definition and Protection of Monumental Trees as Natural Assets that Must Be Protected” is crucial. Additionally, the implementation of specialized maintenance protocols for monumental trees in accordance with TS 13190 "Monumental Trees - Protection and Maintenance Rules," as mandated by law, is essential to mitigate many of the challenges currently faced.

To ensure the sustainable transfer of monumental trees inherited from the past to future generations, it is compulsory that these trees are maintained diligently and regularly by specialized teams. This maintenance is essential for preserving their dimensions, which confer their status as monumental trees (Çevikçelik, 2021; Sapan, 2024).

The rules for the protection and maintenance of monumental trees are outlined in the TS 13190 standard, titled “Monumental Trees – Protection and Maintenance Rules.” This standard delineates various maintenance protocols, including nutrient supplementation, wound care, cavity filling, soil aeration, safeguarding the soil within the root zone, procedures for addressing soil compaction in the root area, disease and pest prevention, and pruning techniques specific to monumental trees. Compliance with this standard, which mandates that all monumental trees in Türkiye be maintained by expert teams, is essential (TSE, 13190).

According to Çevikçelik (2021), the legal procedures surrounding trees with such characteristics aims to ensure that these living natural assets benefit from protective measures established within the legislation. The associated laws, regulations, and directives aim to provide adequate living conditions for monumental trees, establish specialized care requirements, and implement penalties for individuals who harm these trees.

RECOMMENDATIONS

Located within the UNESCO World Heritage-listed Bursa Hanlar District, the monumental plane trees, along with the site's structural and vegetative elements, constitute an integral component of cultural and natural heritage. The same level of attention devoted to the preservation and restoration of architectural structures should also be extended to these monumental trees. As living elements of our natural heritage, monumental plane trees derive their ecological and symbolic significance from being maintained within appropriate habitat dimensions. Representing both the identity of 'Green Bursa' and the legacy of the Ottoman Empire, these trees serve as key landmarks and attraction points for ecotourism.

Based on the findings of the study, the following practices are recommended for the conservation of monumental plane trees to ensure their continued vitality and preservation of their monumental characteristics;

• To address the insufficient spatial requirements for roots observed in 95% of trees, it is imperative to expand the soil area wherever feasible. Additionally, the region extending to the crown edge line (the protective zone of the monumental tree) should be safeguarded against construction activities, and the introduction of other plant species in this area should be avoided.

• Completely sealing the living space surrounding the trunk of the trees with impermeable materials poses a significant risk to the long-term vitality of the trees. For such cases, it is essential to maximize the available green space and ensure adequate ventilation for the roots.

• It is advisable to aerate and loosen the soil of monumental trees that are unable to draw necessary water and absorb necessary oxygen due to soil compaction.

• Any cavities and rots that develop on monumental trees should be addressed by specialized teams. Depending on the severity of the issue, the most suitable open or closed treatment method should be employed. Furthermore, measures should be implemented to prevent individuals from filling these cavities with waste thereby exacerbating the tree's condition.

• Pruning should only be conducted when there is a valid reason, and any proposed pruning should be discussed and justified beforehand.

• Wounds inflicted on trees due to pruning or other causes should be treated promptly and appropriately.

• It is recommended that authorized institutions and organizations establish dedicated units for the management of monumental trees, focusing on their pruning, maintenance, and protection, staffed by trained personnel overseen by subject matter experts.

• The maintenance and oversight of monumental trees should be conducted on a regular and ongoing basis.

• Initiatives should be undertaken to enhance public awareness regarding the significance and preservation of monumental trees, as well as to mitigate potential human-induced damage.

• "Article 65, Paragraph 1 of Law No. 2863 (1983) prescribes legal penalties for intentional acts that harm registered monumental trees, including demolition, degradation, destruction, and physical damage. Unauthorized construction or interventions within their protection zones are also subject to sanction.

Offenders may face imprisonment from two to five years and judicial fines of up to five thousand days. This provision is designed to act as a legal deterrent for the protection of natural heritage.

• The responsibility for maintaining and protecting monumental trees is assigned to Municipalities and Special Provincial Administrations. This is based on Article 7/1-o and 7/2-d of the Metropolitan Municipality Law No. 5216, Article 14/1-b of the Municipality Law No. 5393, and Article 526 of the Special Provincial Administration Law No. 5302. These duties are coordinated by the Ministry of Environment and Urbanization, as stated in Article 10 of Law No. 2863 on the Protection of Cultural and Natural Assets. Monumental trees located within conservation areas (defined by crown diameter projections) are legally recognized as cultural and natural assets. If these trees are not preserved in the appropriate form or health, the responsible institutions may be held liable under the principle of administrative service fault (Çevikçelik, 2021; Sapan, 2024).

Data Availability

Data is available upon reasonable request.

Author Contributions

Conception and design of the study: SÇÇ, KE; sample collection: SÇÇ; analysis and interpretation of data: SÇÇ, KE; statistical analysis: SÇÇ, KE; visualization: SÇÇ; writing manuscript: SÇÇ, KE.

Conflict of Interest

There is no conflict of interest among the authors in this study.

Ethics Statement

We declare that there is no need for an ethics committee for this research.

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